



VEOLIA WATER EAST

Adapting to Climate Change

A report to Defra and the Secretary of State in response to a direction to report under the Climate Change Act 2008

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NOTE

This document has been compiled in order to comply with the new requirement to report our climate change adaption strategy to DEFRA. The format of the executive summary of this report is as specified in the evaluation guidelines issued by Cranfield University

EXECUTIVE SUMMARY

1. Information on organisation	
Name of organisation	Veolia Water East Limited
Organisation's functions, mission, aims, and objectives affected by the impact of climate change	<p>We are a water only supply company operating in the South East of England. This is one of the driest regions of the country. We supply 29 million litres of water a day to 154,000 consumers and 4,000 businesses across a supply area measuring around 352km².</p> <p>As a water services company, our business operations are intrinsically linked to the weather. Our functions which we believe may be affected by climate change are:</p> <p><i>Managing Water Resources Sustainably:</i> Sustainable water management is at the heart of our business. Our job is to ensure that supplies of water to our customers remain secure and of the highest quality with least effect on our environment.</p> <p><i>Meeting Future Demand for Water:</i> We have a duty to provide sufficient quantities of water to meet the demands of all our customers. We work to reduce the increase in future demand for water through water efficiency operations, reducing leakage, and providing information to our customers on the importance of saving water.</p> <p><i>Providing Water Which Meets Drinking Water Inspectorate Standards:</i> We are committed to providing safe, high quality drinking water for our customers. We do this by operating and maintaining our assets diligently along with sampling and testing the quality of the water we supply. We achieved 100% compliance in treated water quality last year.</p> <p><i>Providing a Reliable Network Infrastructure which Adheres to Regulation:</i> We have approximately 1,000 kilometres of water mains many of which lie in soil prone to movement from shrinkage and expansion. These pipes are sensitive to adverse weather conditions.</p>

2. Business preparedness before Direction to report was issued.

<p><i>Has your organisation previously assessed the risks from climate change?</i></p>	<p>We have assessed the risks from climate change as part of our Water Resources Management Plan, Drought Management Plan and Business Plan. Climate change is just one of the strategic risks accounted for in our planning. We also undertake research to assess the risk of climate change across sections of our business which are not fully understood.</p>
<p><i>If so, how were these risks and any mitigating actions incorporated into the operation of your organisation?</i></p>	<p>Our statutory functions, powers and duties are established in UK law through relevant legislation principally the Water Industry Act 1991 and its subsequent amendments. The UK water industry is highly regulated through a number of organisations including:</p> <ul style="list-style-type: none"> • Ofwat (The Water Services Regulation Authority) the economic regulator of the water and sewerage sectors in England and Wales. • The Environment Agency are responsible for protecting the environment and provide Guidelines for producing Water Resources Management Plans and Drought Management Plans. • The Drinking Water Inspectorate who continually monitor the quality of the water that supplied to ensure that it complies with EU and UK standards. • The Health and Safety Executive within the workplace. • Non-government agencies, including consumer organisations and environmental stakeholders, also play a large part in informing water policy and practice across the sector. <p>Amongst other regulatory submissions, we are required to prepare and submit Business Plans to Ofwat and, Water Resources Management Plans and Drought Management Plans to the Secretary of State to explain our proposals for securing and maintaining supplies of water over a 25 year planning horizon. The process of preparing and submitting these documents has enabled us to assess the impact of, formulate action plans for, and secure funding to enact climate adaptation measures. The Plans are reviewed and updated annually between regulatory submissions.</p>

3. Identifying risks due to the impacts of climate change

What evidence, methods, expertise and level of investment have been used when investigating the potential impacts of climate change.

Our approach to investigating the potential impacts of climate change differs according to risk factor and the following methods have been used. In all cases UKCP09 projections of future climate change have been used as the standard climate change forecast:

Water scarcity. Studies have been carried out including forecasts of the amount of water available to meet the demand of our customers until 2035. We are able to quantify effects on both our future supply capability and customer demand. This work culminated in our Water Resources Management Plan and Drought Management Plan.

Flood Risk. Our recent flood risk study was undertaken by independent consultants Jacobs to identify potential sites at risk, and quantify the threat.

Reduction in Network Resilience. To assess the potential impact of climate change on burst rates, we have evaluated historical data to produce a qualitative review of this risk. This data is analysed in our Business Plan and as part of the demand management options appraisal in our Water Resources Management Plan.

4. Assessing risks

How does your organisation quantify the impact and likelihood of risks occurring?

Our risk register ranks our strategic risks with a calculation that considers the likelihood and severity of each risk. This allows for easy comparison of areas needing action more than others. Likelihood is scaled from “(0) Zero Likelihood” to “(5) Likely and Imminent” with severity scaled similarly. Severity of 13 categories is assessed for each risk with the sum of these scores multiplied by likelihood to give a final risk score between 0 and 325.

Water scarcity. We quantify the future supply/demand balance and also assess their uncertainty. First future water resource availability is calculated as detailed in our Water Resources Management Plan. This study considered factors likely to reduce supply levels such as climate change. Secondly, future demand levels are forecast assessing ownership, frequency and use of water using appliances and behaviours and by combining estimates of the effect of water efficiency with future population forecasts. To account for uncertainty and flexibility, a ‘headroom’ margin is applied to the supply demand balance.

Flood Risk. We commissioned consultants Jacobs to assess the effect flooding may have on our water production sites. This study quantified the level and frequency needed for a flood to cause damage and/or loss of supply.

Reduction in Network Resilience. Reduction in network resilience is more difficult to quantify and requires more qualitative and expert analysis of the risk. Where possible, historical data has been used and results from other studies including UKCP09 projections.

5. Uncertainties and assumptions

<p>What uncertainties have been identified in evaluating the risks due to climate change?</p>	<p>Uncertainties identified during the compiling of this report are explained in detail in Section 6 – Uncertainties.</p> <p><i>Legal and regulatory uncertainties:</i> Our legal and regulatory responsibilities will evolve over time and we will face new challenges that may affect our plans for climate change adaption.</p> <p><i>Data reliability:</i> We have used a range of external data sets such as the UKCP09 projections as well as flood maps from the Environment Agency. This data is the most accurate available but as with all forecasts, an element of uncertainty remains. We have allowed for a level of uncertainty in our planning where the scale of risk has been assessed.</p> <p><i>Water quality:</i> We are aware that climate change may affect the quality of our raw water resources however this is uncertain</p> <p><i>Effects of climate change:</i> The scale of UKCP09 projections are based on a range of global weather models with inherent uncertainty, accordingly the frequency and severity of extreme weather events are difficult to accurately predict.</p> <p><i>Risks to administrative operations:</i> Like all businesses, we rely heavily on a number of other key sectors such as ICT, transport, and energy generation. We are unsure as to how climate change may have consequences on our ability to maintain operations until we can quantify the effect of climate change on these sectors which remain key to our service.</p>
<p>What assumptions have been made?</p>	<p>We have assumed that external data and projections are accurate but included an assessment of uncertainty in our analysis.</p> <p>We also assume that future financial, regulatory, and legal circumstances will remain relatively unchanged and that our business functions will not be significantly different within our planning horizon. For example, we assume that our operational area and business model remains constant and that we will continue to be fully funded to fulfil our regulatory obligations and targets.</p>

6. Addressing current and future risks due to climate change - summary

<i>BUSINESS FUNCTION</i>	<i>CLIMATE VARIABLE</i>	<i>PRIMARY IMPACT OF CLIMATE VARIABLE</i>	<i>THRESHOLDS ABOVE WHICH THIS WILL AFFECT BUSINESS</i>	<i>LIKELIHOOD OF THRESHOLDS</i>	<i>POTENTIAL IMPACTS ON ORGANISATION AND STAKEHOLDERS</i>	<i>PROPOSED ACTION TO MITIGATE IMPACTS</i>	<i>TIMESCALE OVER WHICH RISKS ARE EXPECTED TO MATERIALISE AND ACTION IS PLANNED</i>
Managing water resources sustainably and sufficiently	Variation in precipitation	Lower surface water levels in shared reservoir as well as lower groundwater levels across region.	Supply/demand balance – if demand has potential to outstrip supply	Minimal. Other sources in region able to compensate for any loss of deployable output from reservoir.	VWE forced to source supplies from elsewhere. No impact on stakeholders or customers during planning horizon.	Monitoring of situation. Evidence shows risk is there but even under worst case scenarios, there will be no impact for stakeholders/customers.	Beyond planning horizon.
Meeting future demand for water	Increase in temperature	Subsequent increase in demand levels	Supply/demand balance – if demand has potential to outstrip supply	Historical evidence shows that if rise in temperature is experienced then rise in demand will be too.	Minimal – supply demand balance shows supply surplus until end of planning horizon at least.	Monitoring of situation. Evidence shows risk is there but even under worst case scenarios, there will be no impact for stakeholders/customers.	Beyond planning horizon.
	Flooding	Loss/damage to physical company assets located within flood plain.	1:1000 year flood event	1:1000 year events = 0.01% likelihood of occurring.	None to customer/stakeholder. If event occurs, only 1 asset is at risk and other sources are expected to be capable of compensating for loss. Impact on company is financial cost of repair of any damage to aforementioned asset.	Flood resilience already higher than projected climate change flood events. Therefore no adaptation programme necessary. Continual monitoring of situation will take place.	Indefinitely providing data is accurate.
Providing a reliable network which adheres to regulation	Variable Temperature Increased unpredictable future weather.	Shrinkage and swelling of ground due to variations in temperature increasing incidence of leaks.	Supply/demand balance – if demand has potential to outstrip supply Financial thresholds - ELL	Unknown although evidence shows correlation between temperature fluctuation and bursts.	Increased burst rate, disruption due to fixing, associated financial, energy, and carbon costs of repair, Cost and disruption of increased replacement of network. Increased water wastage, potential for supply to not be sufficient due to leakage.	Continued replacement of network, continued efforts to reduce pressure in network, providing alternative methods of asset delivery, improvements in monitoring and prediction so that leaks can be found and fixed quickly, environmental accounting to justify investment. No specific adaptation programme needed due to supply surplus....adherence to leakage targets accomplishable despite potential for more bursts/leakage in future.	Adherence to ELL until cost of repair outweighs cost of replacement. Timescale not currently definable.

7. Barriers to Implementing adaptation programme

<p><i>What are the main barriers to implementing adaptive action?</i></p>	<p><i>Regulation and Legislation:</i> Many of our regulatory requirements are not conducive to a climate change adaptation programme. For example, our financial regulation structure makes justification of long term projects difficult with a relatively short 5 year Business Planning cycle. We propose to work closer with our regulators to resolve these issues.</p> <p><i>Resources:</i> We may find ourselves in a situation where adaptation actions have been identified but investment has not been included within price limits for the near future e.g. Flood works. As a result we are unable to devote resources to ensure successful completion of the programme. This is a problem all companies will face and we will have to develop a new framework to evaluating the costs and benefits for projects specifically aimed at adapting to climate change.</p> <p><i>Knowledge:</i> Uncertainties in many areas are preventing us from acting. Devoting substantive resources on projects based on qualitative or indicative data is unwise. With more information on the specific effects of climate change, we can create specific adaptation actions which we are sure are appropriate. We will continue our research and collaboration with relevant authorities to overcome this.</p>
<p><i>Has the process of doing this assessment helped you identify any barriers to adaptation that do not lie under your control?</i></p>	<p><i>Interdependencies and Stakeholders:</i> We must justify our operations not only to our regulators but to our customers and other relevant stakeholders also. For example, we may not justify projects to improve water quality if the outcome of this project is detrimental to the environment. We also rely heavily on other sectors, for example energy production and transport. If these sectors are unprepared then these may undermine our adaptation actions. To overcome this we will continue to liaise with all relevant stakeholders and interdependencies and aim to work together to overcome barriers.</p>

8. Report and review

<i>How will the outcome of the adaptation programme be monitored and evaluated and what is the timetable for this?</i>	We monitor the outcome of our projects and report these annually in regulatory returns. We prepare Plans for submission to our financial regulator on a 5 yearly basis and we consult on and prepare Water Resources Management Plans that include assessment of investments needed to adapt to accommodate climate change effects for approval by the Secretary of State. These Plans are monitored and updated annually.
<i>How do you propose to monitor thresholds above which impacts pose a threat to your organisation (including the likelihood of these thresholds being exceeded and the scale of the potential impact)?</i>	Where current thresholds are known, we will continue to monitor these and report via our Plans. Where thresholds are currently unknown, our periodic monitoring will ensure that when this information becomes available we will be in a position to act on it.
<i>How will the benefits of the programme be realised and how will this feed into the next risk assessment and options appraisal?</i>	Information relating to identified issues will then feed into our corporate risk register which is continually updated. If and when additional issues arise, these will be assessed and added to the risk register. Monitoring of this will take place and be reported on in our Plans.
<i>How have you incorporated flexibility into your approach?</i>	Our constant monitoring and evaluation approach enables us to remain flexible to respond to risks as they materialise.

9. Recognising opportunities

<p><i>What opportunities due to the effects of climate change and which the organisation can exploit have been identified?</i></p>	<p>No opportunities that have the potential to make a noticeable difference on our operations have been identified.</p> <p>If and when opportunities do materialise, these will be reported on in our Plans.</p>
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10. Further comments/ information

<p><i>Do you have any further information or comments which would inform Defra (e.g. feedback on the process, the statutory guidance, evidence availability, issues when implementing adaptation programmes, challenges etc)?</i></p>	<p>Climate change adaptation is embedded in our long term investment planning to secure an adequate margin over 25 years between water resource availability and demand for water.</p> <p>Investment in metering and leakage reduction increases network resilience and reduce environmental impacts by reducing demand for water therefore reducing our requirement to abstract water from streams and aquifers which may be adversely affected by the effects of climate change.</p> <p>We will work closely with our financial and environmental regulators to address this issue in the next period.</p>
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1 INTRODUCTION

Veolia Water East (VWE) supplies water to approximately 154,000 people and around 4,000 businesses within an area of 352km² across the Tendring Peninsula in Essex. We provide a reliable, safe supply of high quality drinking water to our customers; and are committed to ensuring a sufficient and continued supply of water in the future.

Our statutory functions, powers and duties are established in UK law through relevant legislation principally the Water Industry Act 1991 and its subsequent amendments. The UK water industry is highly regulated through a number of organisations appointed by Defra including:

- Ofwat (The Water Services Regulation Authority) the economic regulator of the water and sewerage sectors in England and Wales;
- The Environment Agency responsible for protecting and promoting the environment;
- The Drinking Water Inspectorate who continually monitor the quality of the water that supplied to ensure that it complies with EU and UK standards,
- The Health and Safety Executive within the workplace.
- Non-government agencies, including consumer organisations and environmental stakeholders, also play a large part in informing water policy and practice across the sector.

Amongst other regulatory submissions, we are required to prepare and submit Business Plans to Ofwat at 5 yearly intervals, Water Resources Management Plans and Drought Management Plans to the Secretary of State to explain our proposals for securing and maintaining supplies of water over a 25 year planning horizon. The process of preparing and submitting these principal planning documents has enabled us to assess the impact of, formulate action plans for, and secure funding to enact climate change adaptation measures.

1.1 Climate Change Adaptation

Section 61 of the Climate Change Act 2008 gives the Government the power to require Reporting Authorities to prepare and submit climate change adaptation reports for the Secretary of State taking into account the reporting guidelines prepared by Defra. As one of around 100 leading organisations we have been required by the Secretary of State to prepare this report detailing;

- How we have assessed that climate change is already impacting, and how it might impact in the future, upon our organisation and,
- Our proposals, if any, to adapt to climate change.

The work of UKCIP and others has produced tools and approaches that can help to identify and assess impacts. This combined with our extensive historical data sets and years of reporting and expert analysis mean Veolia Water East is in a robust position to identify and evaluate potential impacts and propose actions to adapt to the emerging risks associated with climate change.

1.2 This Report

Our report follows a similar format to that of the executive summary from the statutory guidance document. To populate this report we have used evidence from our Business Plan, Water Resources Management Plan, Drought Plan, and a number of our other published documents.

Climate change is just one of the strategic risks embedded in our company conscience. Where possible, we have detailed current adaptation actions, as these are already published in statutory plans. Where we have identified potential consequences, not covered by existing plans, we have made suggestions of what should be implemented.

2 WHO WE ARE AND WHAT WE DO

Current Defra climate change scenario predictions indicate that weather in our region will become more extreme in the winter and summer. Average annual precipitation will remain relatively unchanged, but will be more intense in the winter leaving us with drier summers.

Water supply is an area where many of the consequences of climate change will be experienced first and most acutely. This puts the water industry at the forefront in adapting to a changing climate. We have experience in planning and adapting to uncertainty in water supply which is reflected in our investment strategies and Business Plans.

2.1 About Veolia Water East

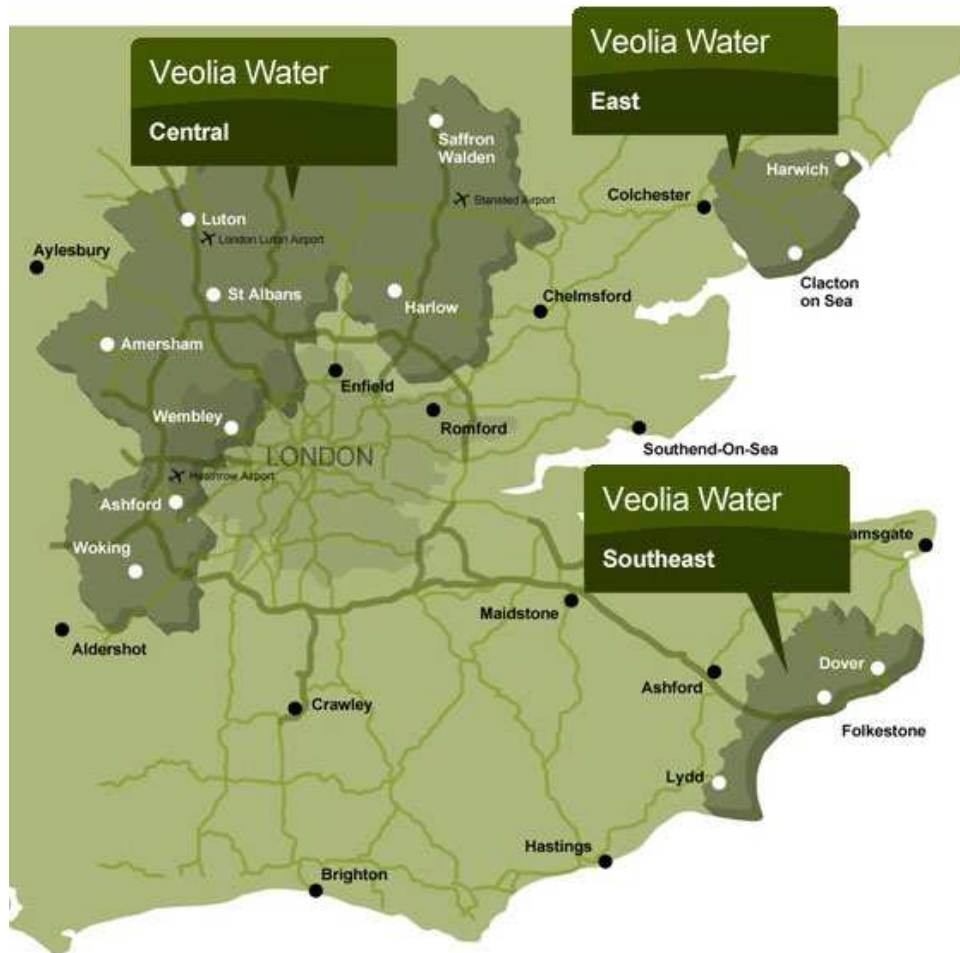
We are a water only supply company operating in the East of England as Figure 2.1.a shows. As mentioned we supply water to around 154,000 people but this population increases dramatically in the summer due to summer holiday makers.

We have two key sources of water. 80% of water supplied is drawn from an underground aquifer. The underground water is of high quality and requires only basic treatment. 20% of water supplied is sourced from the River Colne and stored in an open reservoir at Ardleigh. This water requires more extensive treatment before being pumped into supply. Our sources provide sufficient water to meet all the current needs of our customers.

We are one of the top performers in the British water industry. We continue to report excellent service levels against Ofwat's performance standards which all fall within the top categories. Where we can do better we continue to show improvement. More than two thirds of our household customers are currently metered and this is the highest ratio in the industry.

We have continually met financial targets, demonstrating efficiencies for our customers and providing a strong platform for investors, securing a sustainable future. The condition of our assets enables us to provide high levels of service and we intend to provide sufficient asset maintenance to continue to provide high levels of service.

Figure 2.1.a: Veolia Water East within the Southeast of England.



2.2 Veolia Water East Business Functions

As a water supply company, our business operations are intrinsically linked to the weather; as the climate changes, so too must the way we operate. The following section identifies our main business functions which we believe are potentially at risk to the climate change predictions detailed by the UKCP09 findings.

2.2.1 Managing Water Resources Sustainably

Sustainable water management is at the heart of our business. Our Water Resources Management Plans show that there is currently sufficient clean, wholesome water available to us, but we also have to balance the competing pressures of economic growth, pollution risk, environmental protection, and of course; climate change. Our job is to find a way of balancing those pressures whilst ensuring that supplies of water to our customers remain secure and of the highest quality.

We must provide this service at a price which the customer is willing to pay for.

2.2.2 Meeting Future Demand for Water

We are obligated to provide water in sufficient quantities to meet the demands of all our customers. We want to do this at a price that is affordable and which takes into account the effects of climate change so that we are able to function as a business into the future.

The continued serviceability of our network infrastructure is essential for the constant delivery of a wholesome product in the quantities demanded. Without the proper and full operation of these assets, we cannot supply water safely and reliably. The identified risks posed by climate change (such as increased flood propensity) could see the reliability of these assets diminished and with it, our ability to meet demand.

2.2.3 Providing Water Which Meets Drinking Water Inspectorate Standards

We have a duty to provide high quality water in sufficient quantities to meet the demands of all our customers. We want to do this at a price that is affordable and which takes into account the effects of climate change.

The quality of raw water from our sources is constantly under threat of pollution and our studies show it is deteriorating. We monitor groundwater, assess risks regularly and install appropriate treatment where necessary to ensure compliance with drinking water standards.

Providing water of sufficient quality is a regulatory requirement, we need to respond with positive action to retain our customers' faith and confidence in our water.

2.2.4 Providing a Reliable Network Infrastructure which Adheres to Regulation

Our network of underground pipes is replaced on average once every 200 years. This rate of renewal is unlikely to be sustainable when you take into account that the pipes are currently designed to last less than 100 years.

We react quickly to ensure that supplies are returned to normal following bursts. If the effects of climate change cause burst rates to increase, it is likely that due to the economics of pipe leakage, pipe replacement will become more common than repair.

3 OUR RISK ASSESSMENT APPROACH

Due to the varying nature of our business it is impossible for us to adopt a single methodology for assessing and quantifying all our risks. We employ different methodologies for different types of risk. This section will describe the risk management process for strategic risks which threaten to affect our business objectives.

Climate change is considered a contributory factor towards some of our strategic risks (for example the risk of long term insufficiency of water), rather than a strategic risk in itself. Appendix C lists the risks which are likely symptoms of the UKCP09 projections on a likelihood/severity matrix. For items such as “BURST RESULTING IN LOSS OF SUPPLY DUE TO GROUND MOVEMENT” climate change may be only a contributing factor towards this risk which in turn is only a contributing factor towards our the strategic risk of guaranteeing sufficient water long term.

It is for this reason that VWE is unable to differentiate the effect that climate change may have on our operational performance despite being well prepared for changes in the environment. Our periodic plans describe the effect of climate change on our operations and the proposed actions to facilitate adaption. It is primarily through this process that climate change risks are identified, explored, and monitored. One of the aims of this report is to demonstrate that we consider climate change in our planning and that, through our continual monitoring and periodic review processes, we are well prepared.

For each of our specific identified risks, the methodology used has been described in the relevant sections of this report.

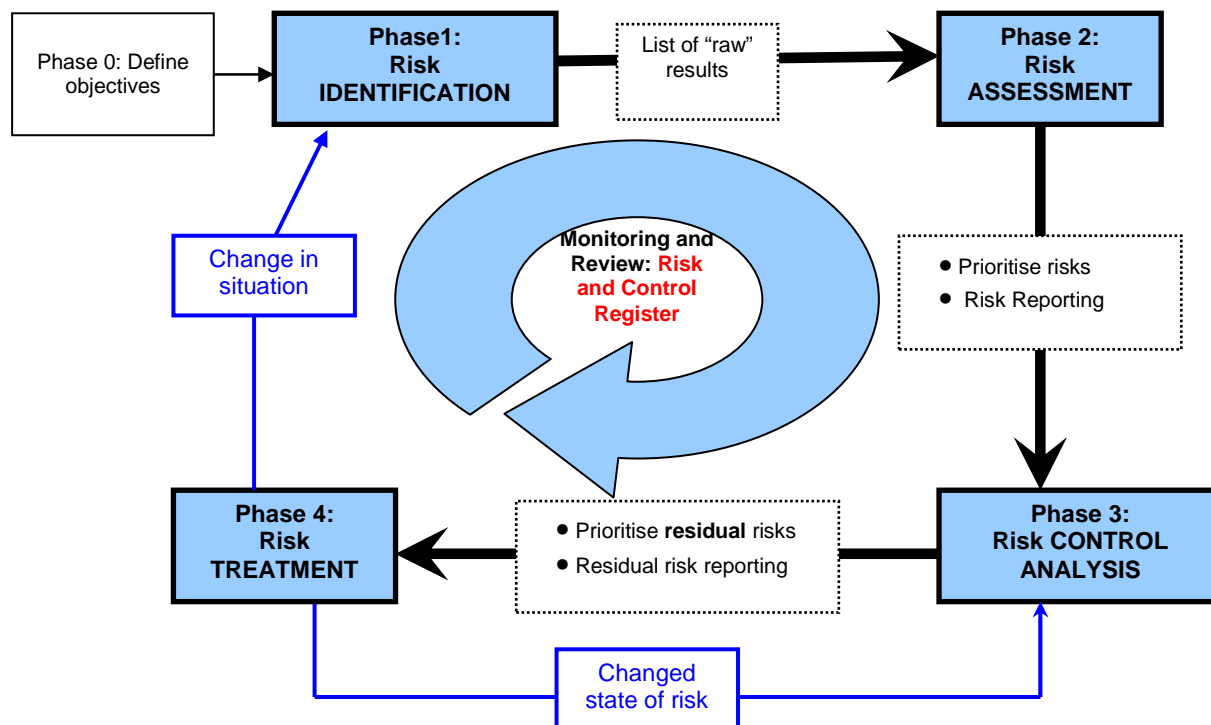
3.1 Significant Risk Management Process

We believe that risk management should be an active, continuous and developing process which runs throughout our organisational strategy and should methodically address all the risks surrounding our current and future activities.

Risk management at Veolia Water East is integrated into the culture of the organisation through an effective policy and program led by senior management. It translates the strategy into tactical and operational objectives, assigning responsibility throughout the organisation and support accountability and reward, thus promoting operational efficiency at all levels.

Our approach is very similar to the UKCIP, Defra and Environment Agency framework (*Climate Adaptation: Risk, Uncertainty and decision-Making - UKCIP Technical Report. May 2003*) in that it is a continuous improvement cycle but as Figure 3.1.a shows; is flexible and appropriate to our organisation and the water industry as a whole.

Figure 3.1.a: Veolia Water risk assessment methodology structure



This section aims to describe the process used when forming our significant risk register. As mentioned, it is not specific to climate change but enables us to remain prepared and flexible to changing conditions. The process itself is in four broad phases, *Risk Identification*, *Risk Assessment*, *Risk Control Analysis* and *Risk Treatment*.

3.1.1 Phase 1 - Risk Identification

Risk identification is the first step of the process and aims to identify where the risks may arise. It has to be approached in a methodical way to ensure that all significant activities within the organisation are identified and all risks flowing from these activities are defined.

Risks are identified as comprehensively as possible by one or more of the following techniques: Check List, Questionnaires, Interviews/Experience, Brainstorming Workshop, Assumption Analysis, Expert Facilitation and by the review of reports including audit outputs, incident investigations, changes in legislation or regulation etc. The approach adopted involves all activity stakeholders and takes into account the experiences they may have had of past comparable projects or existing operations.

Following successful completion of the identification phase, each risk is entered into the risk register under the "Significant Risk" heading.

At this point in the process the 'risk owner' is identified and allocated; usually someone whose activities would be affected if the threat materialised. .

3.1.2 Phase 2 - Risk Assessment

Once the risks have been identified in sufficient detail, they can be assessed in terms of probability of occurrence (likelihood) and potential impact (severity) of that occurrence in order to provide a ranking to prioritise those that are most significant. In doing so, risk

response is targeted to achieve the greatest effectiveness in risk reduction based on these two parameters. The assessments are undertaken by those experienced with the risks in question. In Phase 2, risks are assessed without controls in place.

The probability for each risk are scored from 1 (zero likelihood) to 6 (likely and imminent) and entered into the "Likelihood" column of the risk register. Table 3.1.a outlines this classification.

Table 3.1.a: Risk Assessment probability classification

	Zero Likelihood	Highly Unlikely	Possible in Long Term	Possible in Med. Term	Likely in Short Term	Likely & Imminent
Likelihood Ranking	Will not happen	Has occurred / will occur in the last / next 10 or more years	Has occurred / will occur in the last / next 5 – 10 years	Has occurred / will occur in the last / next 3 – 5 years	Has occurred / will occur in the last / next 1 - 2 years	Has occurred / will occur several times per year

Once a score for likelihood has been obtained, a different process is used to determine the severity of each risk. The impact/severity should be scored from 0 (zero impact) to 5 (very serious). The severity for each risk identified is scored against 13 potential impact categories to the company. These are listed below:

- Water Quality
- Financial
- Sufficient Water
- Overall Service Levels
- Regulatory
- Reputation
- Security
- Health and Safety
- Customer Satisfaction
- Staff Morale
- Legal
- Environment
- Corporate Governance

Guidance for scoring severity is provided in Table 3.1.b and the evidence and expert opinion are described for the risks mentioned in this report

Table 3.1.b: Risk Assessment severity classification

Severity Category	0	1	2	3	4	5
Water Quality	No Impact on water quality	Near miss situation	Reliant on standby measures, action required to rectify	Significant DWI Notifiable incident	Potential DWI / other regulatory prosecution	Potential crown prosecution e.g. corporate manslaughter
Financial	No financial impact/positive financial impact	Negligible	Minor	Considerate	Large financial costs	Massive costs
Insufficient Water	No impact	Minor amount of population at risk of insufficient water.	Small amount of population at risk of insufficient water.	Considerable number of people affected.	Drought risk	Around half of population at risk
Overall levels of service	No impact	downgrading of ranking on any one DG indicator	Downgrading of ranking on more than one DG indicator	Downgrading to bottom of league on one DG Indicator	Downgrading to bottom of league in more than 1 DG indicator or not meeting our leakage target	Withdrawal of licence
Regulatory (i.e. Ofwat)	No contacts	Confidential contact (telephone/letter)	Request for additional information requirements.	Regulatory questioning	Regulatory penalty	Withdrawal of licence
Reputation	No adverse media attention/coverage	Local media coverage 24-48 hrs	Sustained local media coverage 7-14 days	National media coverage 24/36hrs	Sustained national media coverage 24/48 hrs or longer	Sustained national / international media coverage
Security	No Security Incidents	Minor, no effect on Operations	Criminal activity having impact on the company but does not effect customers or the public.	Criminal activity against the company which impacts on the public or customers	Specific criminal or terrorist action leading to non-availability of major asset.	Multiple Terrorist attack

Health, Safety	No Impact-	Non-reportable injury	Reportable accident	Serious reportable injury requiring long term absence	Multiple serious injuries	Loss of life
Customer satisfaction	No customer complaints	Failure to meet customer expectation.	Major disruption,	Repeated extensive disruption	Loss of several principal customers.	Withdrawal of licence.
Staff morale	Employee satisfaction high	Employee satisfaction very good	Employee satisfaction from staff survey good	Employee satisfaction from staff below average	Staff turnover increases	Staff turnover unsustainable
Legal	No impact	Notification of claim by third party	Civil claim for damages	Criminal prosecution	Successful Crown Court Prosecution	Massive fine against the company
Environment	No adverse environmental impact	Minor impact to local area	Significant impact in local area	Significant pollution	Localised evacuation	Long term or Irrecoverable damage
Corporate Governance	No system failure	Minor breaches	Repetitive minor breaches	Low impact	Impact at company level	Complete failure or non- existence of control system.

These categories are individually scored from 1 to 5. The sum of all severities is multiplied by the likelihood rating to give an overall risk score. Therefore the highest score achievable is 390 indicating a very serious threat to the business. This manner of scoring allows for quick and easy ranking of risks in order to highlight where control actions are needed most.

3.1.3 Phase 3 - Risk Control Analysis

The purpose of this phase is to identify controls that can help mitigate and manage the risks that have been identified and scored in Phase 1(risk identification) and Phase 2 (risk assessment). This is the responsibility of the risk owners and line managers who are responsible for the activity.

A similar process used to identify risks is used to identify potential controls. This stage aims to assess if the current control is appropriate.

There are many different types of controls. They tend to fall into four categories.

- **Directive controls** – defined instructions and include things such as policies, procedures, signs, posters etc.
- **Preventative controls** –ensure that appropriate access is maintained, for example: locks, fences, passwords, training, physical barriers, software barriers .
- **Detective controls** – ensures that there is appropriate accessibility to information, such as: testing, inspections and sampling records.
- **Corrective controls** –ensure that identified issues can be remedied. This may be applied in situations where it may be impossible to predict when and where an incident may happen and include continuity planning ensuring gaps can be filled, technical solutions can be applied and training can be provided.

Once existing controls currently in place to mitigate risks have been identified, the likelihood and the severity of the risk will be re-assessed in the same manner as detailed in Phase 2, in order to calculate a the residual risk. If no controls exist the residual risk score will stay the same as the initial risk score calculated in Phase 2.

When controls are identified and residual risk scored, this information is added to the risk register and a ranking given to each identified risk to highlight where additional action is needed.

3.1.4 Phase 4 - Risk Treatment

Effective risk management requires a reporting and review structure to ensure that risks are effectively identified and assessed and that appropriate controls and responses are in place. Existing controls identified in Phase 3 will be monitored by the risk owner and it is their responsibility to decide if the residual risk score is acceptable. If the residual risk is too high or if there are no current controls in place for the risk, new controls have to be implemented as action plans to mitigate the risk.

If the residual risk score is not acceptable the risk owner needs to decide upon a suitable target score and create actions to help reach that target score. The actions will attempt to help the risk reach the target score through either mitigation, avoidance (or both) and to help monitoring the process, determine a date when this new action is to be completed by and the risk management representative who will be responsible for it.

For each of these instances we evaluate the potential next steps, known as “The 4 T’s”. These are:

- **Tolerate**

We reluctantly choose to accept the inherent risk: the cost of control outweighs any potential benefits. Tolerated risks are common and steps are always taken to ensure that the risk is minimised. As and when a suitable control action is identified, it may be implemented.

- **Terminate**

The project or operation is cancelled or ceased. This occurs if the threat of the risk is too great and no suitable control action can be found.

- **Transfer**

The responsibility of the project or operation is shared with another organisation, for example, external contractors are hired. For specialist projects, it is often the preferred route in order to ensure that the project is undertaken by staff appropriately equipped for the associated risks. This option however is only used if all internal possibilities have been explored.

- **Treat**

The risk is reviewed and an appropriate control action developed which is fit for purpose. This would involve controlling and managing both the likelihood and severity of the risk on the project or operation.

At the end of this phase, when the action plan has been implemented, the risk is reassessed, with the outcome from the action forming the new current control in the register. The risk, with the new control, is then rescored and the risk owner compares this score with the action logs original target score. The risk owner then assesses whether the new residual risks score is now acceptable. If not, a new target score is selected and a new action plan is drafted. This form of review continues until either the situation changes and then the process restarts at Phase 1, or all the possible controls have been applied and the risk is at its lowest score.

If risk materialises despite mitigation (for example: flood defences fail) contingency plans are put in place in order to react to the situation. Contingency plans are also a form of corrective control and can be used when the cost of removing the risk or applying other controls is excessive.

4 RISKS TO VWE BUSINESS FUNCTIONS FROM CLIMATE CHANGE

As a business we aim to meet our customers demand with clean and safe drinking water at an acceptable price. The following section outlines the consequences of climate change which could have an effect on this aim.

Appendix C transfers the issues mentioned in this chapter to a likelihood/severity matrix. Although this is not standard practice, as Section 3 describes, it allows for quick identification of our high priority risks.

4.1 Water Scarcity

UKCIP CP09 projections predict an increase in the frequency of dry summer weather and so proper planning in this subject is taken very seriously in order to ensure sufficient quantities of potable water are available for our customers. For this reason it is important to have accurate predictions regarding if, and how, water scarcity might affect us.

Our *Water Resources Management Plan* has a planning horizon of 25 years. We have used the UKCIP09 findings for weather scenarios throughout the 21st century and have considered the worst case scenarios during our approach.

Figure 4.1.a: Schematic representation of WRMP Studies

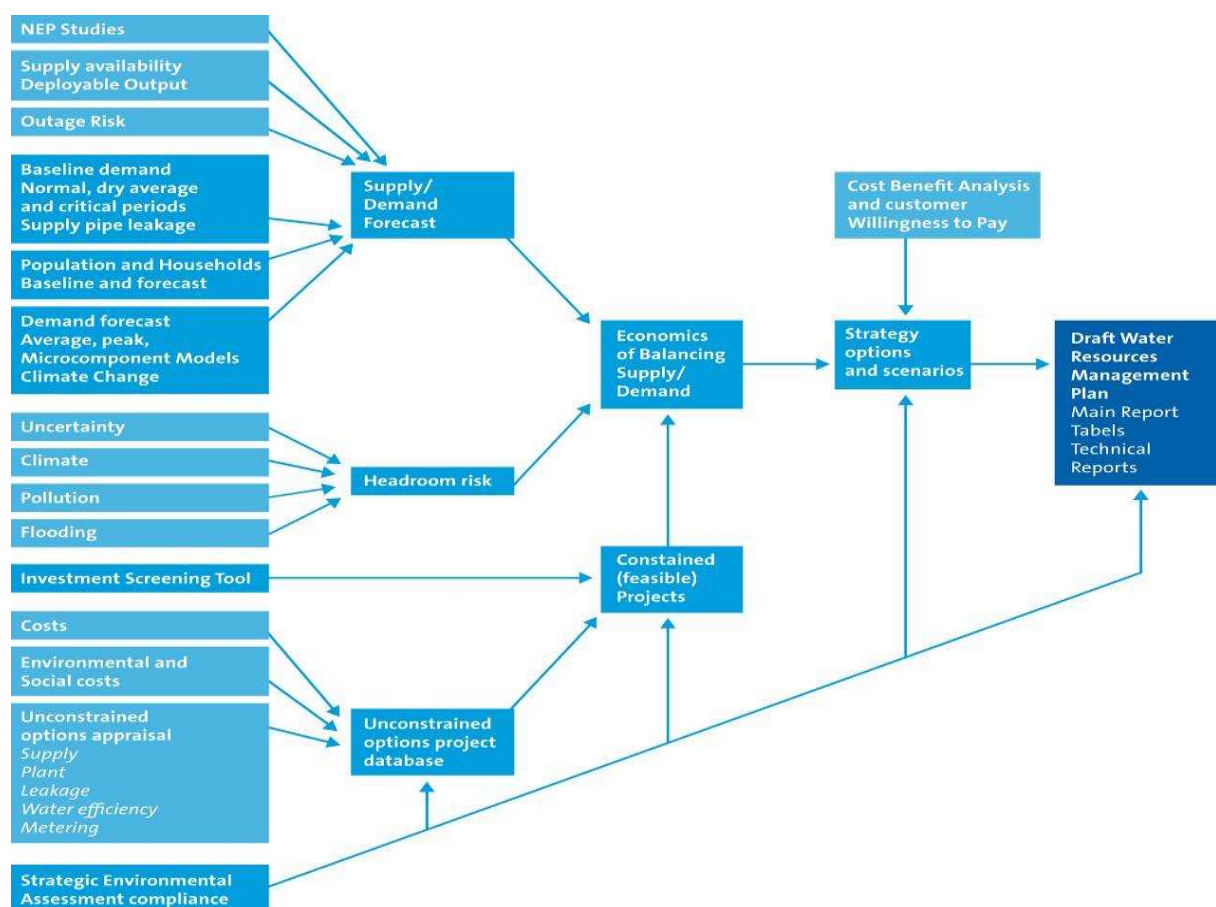


Figure 4.1.a demonstrates the scope and quantity of studies that go into our methodology for assessing supply and demand risks. Our approach is informed through years of data and experience and we consider it to be appropriate for use. Findings from the studies are then

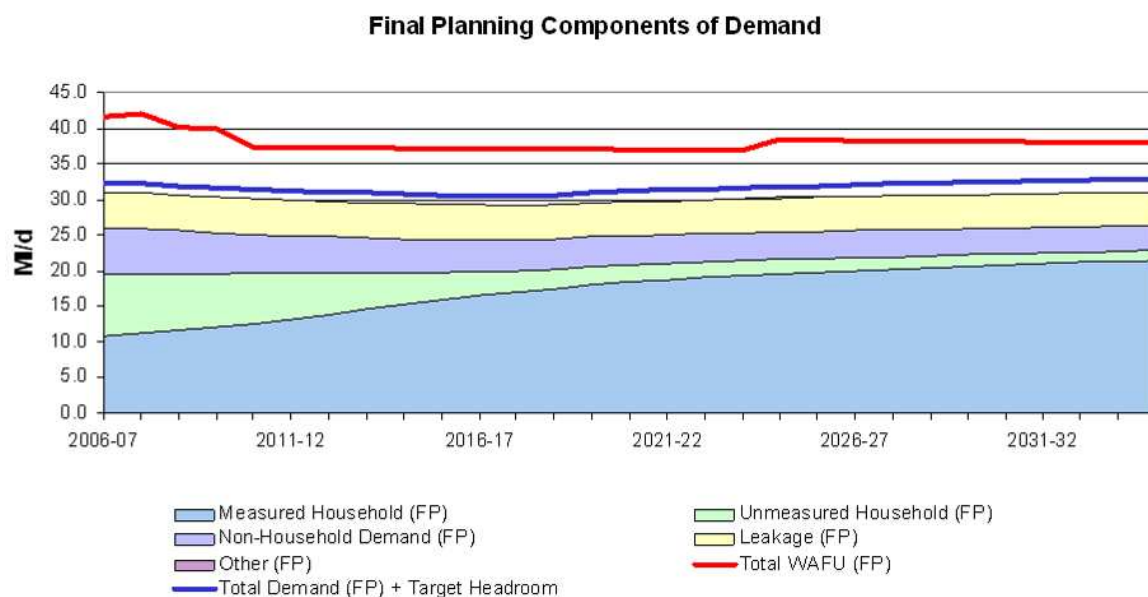
evaluated and individually weighted by our experienced engineers to generate a well informed and balanced plan. Copies of the technical reports are included on our website¹.

4.1.1 Demand Changes

Added pressure on present and future water resources is imposed by expanding urban environments. We recognise that in our region, further urbanisation generates increases in population and houses. Our plans will need to be both flexible and robust in the longer term to ensure we develop new resources where necessary and, in conjunction with demand management, moderate the demand for water and reduce leakage.

The impact of climate change on demand has been assessed within our headroom calculations, using the 1998 UKWIR Headroom Methodology. We have extensively examined the regional estimates of the consequences of climate change on domestic demand within *Climate Change and the Demand for Water* (Downing et al., 2003) and taken this into account when considering the effects of climate change on domestic demand in our Region. Figure 4.1.b illustrates the scope and quantity of all components used in our calculations for demand throughout our planning horizon.

Figure 4.1.b: Detail of all demand components set against water available for use



Increase in demand is a difficult factor to quantify and this is reflected in the headroom of our predictions. Our headroom considers the uncertainty in our calculations as well as providing a safety margin allowing for flexibility within our operations. We know that increases in temperature cause increases in demand, as is historically seen during hotter weather, but when combined with our continued water efficiency operations, we are unsure as to its entire effect in terms of future demand over time. Our WRMP work indicates that demand could rise if water efficiency activity is not implemented, and this is likely to be further exacerbated by climate change.

Our studies suggest that climate change may affect demand by approximately -3% by the mid 2020s under severe climate change effects. This is classified as a low impact under the UKWIR/EA headroom methodology, and has been scored accordingly in the point scoring

¹ <https://east.veoliawater.co.uk/>

headroom method. This method is considered appropriate for us as a result of the our supply-demand surplus. The point scoring method suggests that climate change and demand contributes only 0.4Ml/d to headroom.

Figure 4.1.c and Figure 4.1.d demonstrate that we have a resource surplus within the lifetime of the Plan. Given this, climate change and demand have no effect on the supply-demand balance. We do not consider any predicted rise in demand through our planning horizon to be a risk to our business, customers, or stakeholders. Figure 4.1.e illustrates current and projected headroom quantities for our baseline and final planning compared against our target headroom. This shows that our current and future headroom is well above what is required and so further increases our resilience to extreme weather events which may result in water shortages.

Demand management is part of our statutory reporting process and so through our continual monitoring and periodic reporting, will be able to adapt if issues arise in the future.

Figure 4.1.c: Baseline Supply / Demand Balance – Dry Year Annual Average

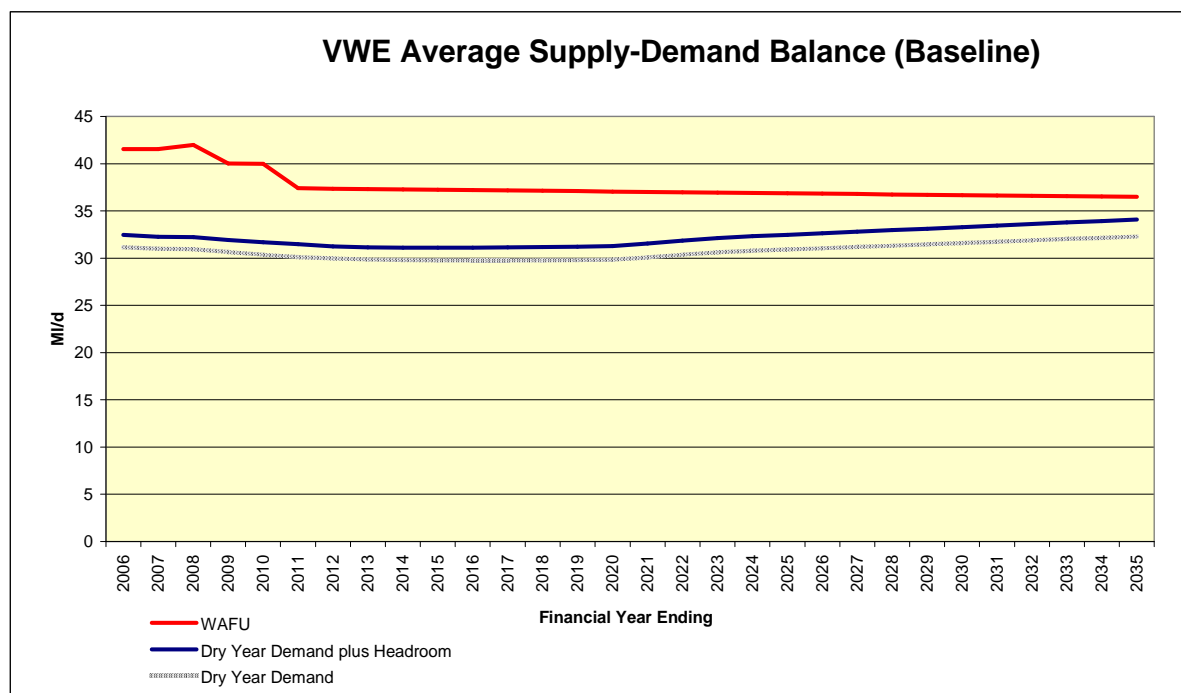


Figure 4.1.d: Baseline Supply / Demand Balance – Dry year critical period

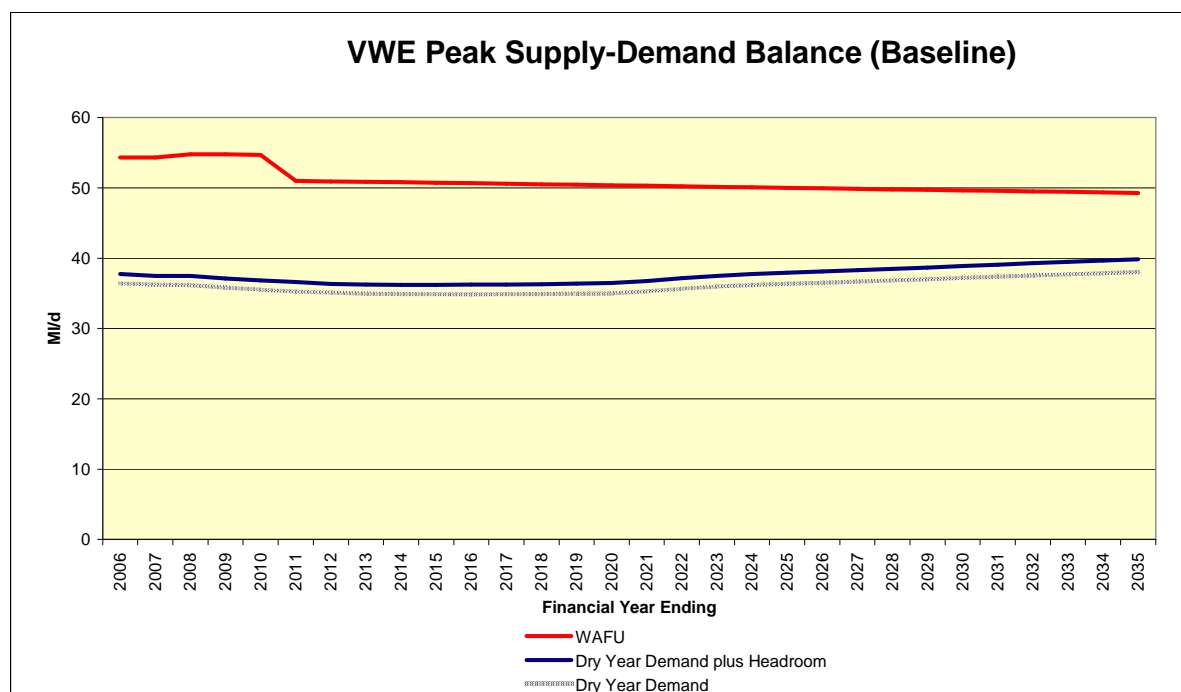
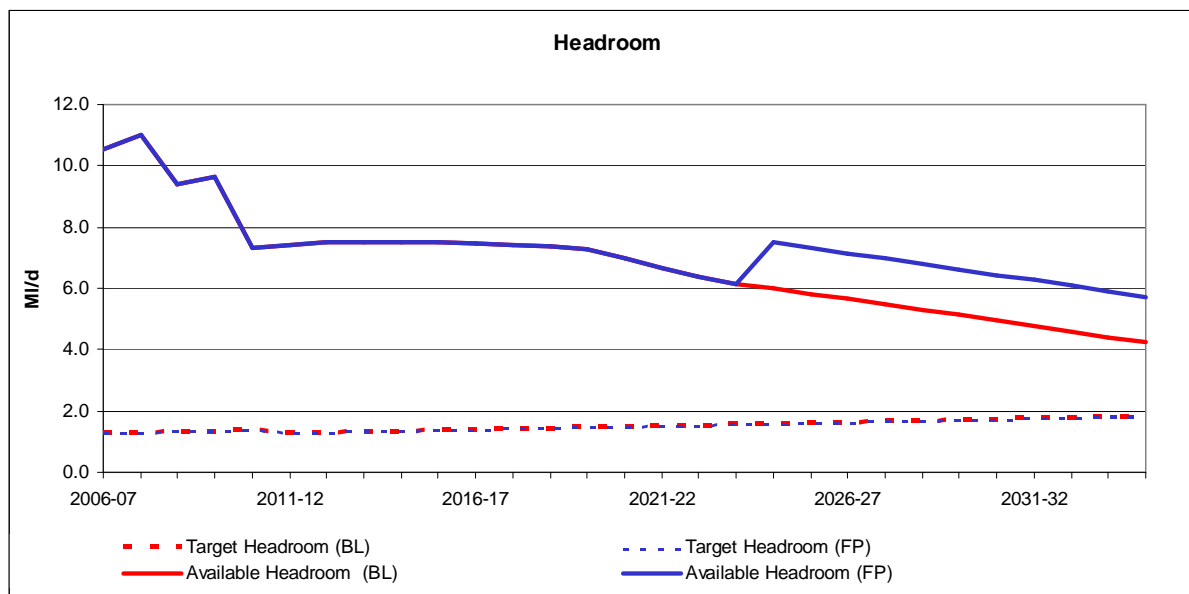


Figure 4.1.e: Summary of predicted available headroom and target headroom



4.1.2 Reduced Surface Water Deployable Output

Our only surface water supply source is a shared reservoir with Anglian Water Services. An assessment of possible consequences of climate change on the shared reservoir concluded that for the median scenarios, a total reduction of 1.42 MI/d at average and peak could be caused by climate change by 2035. This slightly reduces the deployable output from this source, but as Figure 4.1.c and Figure 4.1.d show, at no point does this cause issues with our supply/demand balance throughout our planning horizon. For this reason, we do not consider our customers or stakeholders to be affected by the reduction in surface water deployable output caused by climate change.

This issue is part of our statutory reporting process and so through our continual monitoring and periodic reporting, will be able to adapt if issues arise in the future.

4.1.3 Reduced Groundwater Deployable Output

In preparing our plan for the next 25 years we considered factors likely to influence the amount of groundwater available, such as climate change. Changing rainfall patterns caused by climate change may reduce the recharge of our underground sources and as already mentioned, increase demand in the summer months at the same time. UKCP09 findings showed that annual precipitation will remain relatively unchanged but will be more intensified during the winter meaning there could be drier summers.

In order to assess our groundwater sources, a risk based approach has been adopted by comparing current water levels, current Deepest Advisable Pumping Water Level (DAPWL) and anticipated changes in groundwater levels. Studies used to calculate our DAPWL are detailed in our Water Resources Management Plan and have concluded that our DAWPL is a maximum of 5 metres below current water levels.

Even applying the highest impact climate change scenarios to our groundwater sources, does not reduce pumping water levels to the DAPWL. In all cases, the DAPWL is

significantly greater than 5 metres from the lowest observed pumping water levels to date. This indicates that these boreholes are unlikely to be significantly impacted by additional declines in water levels.

It is for this reason that despite difficulties (as explained in our Water Resources Management Plan) in accurately predicting groundwater levels through our planning horizon, we are confident that current deployable output projections are high enough to account for any uncertainties.

Combined source capacity significantly exceeds treatment works capability, thus changes to individual source yields due to any climate change impact are very unlikely to result in a reduction of Deployable Output. However, we consider it prudent to allow a small reduction in DO of 1% to reflect the impact of climate change on the source outputs and the wider aquifer system. This equates to approximately 0.31MI/d at average and 0.39MI/d at peak. However, even this appears unduly pessimistic, especially at average, as declines in output from an individual source could be managed by increasing the take from another source less impacted and still be within current licence totals. At peak capability, the sum of the individual boreholes exceeds that of the treatment works capability by some 22MI/d. However, these values have been used in the climate change analysis.

The only issue with such an approach, is that the Environment Agency may find that the impacts of climate change on the environment are so severe that they would either wish us to reduce abstraction, or for additional river support to be made. No such comments have been received from the Environment Agency. We will continue our close working relationship with the Environment Agency to ensure that should this event occur, our customers experience as little disruption as possible.

In summary, it has been calculated that by the end of our planning horizon, the potential impact on our groundwater sources will be a reduction of 1.02MI/d at average and 1.11MI/d at peak. These numbers have been applied linearly throughout the 25-year period (0.04MI/d decline in resource per year), accounting for a declining trend in available DO and hence WAFU.

Climate change also has the potential to affect drought event frequency. However, no significant problems were encountered during previous groundwater drought periods in the South-East of England including 1988-1992, 1996-1997 and 2006-2007 or during the record peak demand of the hot and dry summer of 1995. As our supply/demand balance has continued to improve there is no likelihood of any problems due to drought in the foreseeable future.

Our studies show that our supply/demand balance will remain unaffected by the consequences of climate change and despite subtle fluctuations in deployable output, our customers, stakeholders, and organisation will also remain unaffected.

4.2 Flood Risk

As mentioned, UKCP09 climate projections point towards a more variable climate with not only an increased chance of drought conditions, but with more intense rainfall patterns also possible. Projections of increased rainfall are likely to result in higher intensity rainfall events, and longer wet periods. This could give rise to increased flooding, which would have consequences for our assets on or near the floodplain. Projections suggest there could be more surface flooding from rainfall (pluvial flooding) with the corresponding increase in risk to water company assets within many urban areas that are not in the fluvial floodplain.

For this reason, we have devoted a significant amount of time and resources to assessing our current resilience to flooding and preparing our defences in line with recommendations made in a number of external reports.

4.2.1 Summary of Methodology Used

Independent consultants Jacobs were carried out an initial assessment of flood resilience by overlaying the Environment Agency 1 in 100 year event and 1 in 1000 year event published flood extents over GIS layers showing the range of our water supply structures across the catchment. This refers to the flood water level expected from flood events across the referred to time periods. For example, a 1 in 1000 year event would be seen once every 1000 years and is therefore an extremely rare event. From this screening process a shortlist of 5 potentially affected sites was drawn up that warranted more detailed investigation in order to produce a more accurate assessment of flood risk.

Having determined the predicted flood levels for each site, a GPS level survey was carried out at each site to establish, in the field, whether any individual structures would be susceptible to flooding. In line with previous flood risk assessments, the flood return periods investigated were as follows:

- 1:20yr
- 1:100yr
- 1:100yr +20% (climate change)

The additional 20% flow represents the consequences of climate change with 1 in 100 year flow +20% events predicted to occur as often as 1 in 100 year flow events by 2115 as per Environment Agency guidance.

4.2.2 Potential Impacts of Climate Change

The survey showed that no structures would likely be inundated by any of the above flood events and the flood mapping indicates that only one site could potentially be at risk from a 1:1000yr event. However the structures at this site are elevated above ground level and are thus likely to be protected even from this extreme event.

The site survey thus shows that all Company structures in our region are likely to be protected from not only the 1:100yr +20% (climate change) event but also the extreme 1:1000yr flood event.

It is for this reason that we do not consider increased flood propensity brought about by climate change to be a concern for our organisation, stakeholders, or customers. We are confident that we will be able to maintain our service in the event of flooding well beyond our planning horizon.

4.3 Reduction in Network Resilience

Loss of water put into supply as a result of leakage contributes to demand. Therefore, monitoring and controlling leakage is integral to demand management and important for maintaining a resilient supply/demand balance. Our network of just under 1,000 km of mains is highly developed and integrated and we report one of the lowest levels of leakage in the industry at 68.02 litre/property/day which is approximately half of the industry average.

Not only do bursts cause loss of water, but are also financially expensive to repair. We are statutorily obligated to meet leakage targets set by our regulators. Water companies which

fail to meet such targets receive adverse publicity and have the potential to receive financial penalties. For these reasons it is important to assess and quantify the likelihood of climate change increasing burst rates.

UKCP09 projections indicate that our future climate may be characterised by extreme differences between winter and summer. Extreme temperature and rainfall variations have the potential to increase bursts and leakage through the shrinking and swelling of the soil caused by changes in soil saturation. Drought, freezing and rapid rainfall will lead to unpredictable movement in the ground, directly increasing the number of burst mains and leaks.

Considering our excellent leakage rate and surplus of supply, we do not currently consider an increase in bursts caused by climate change to be a concern to our organisation, stakeholders or customers. We will continue to monitor this important part of our business to ensure that quantities of water lost through leakage do not negatively affect our supply/demand balance and that we are able to maintain our record of meeting leakage targets at an affordable price.

5 PROPOSED ADAPTATION ACTIONS

5.1 Adaptation to Water Scarcity

Here at Veolia Water East, we take water efficiency to mean using less water, by using water wisely and reducing water wastage. Managing demand is good for sustainability and avoids the need for any additional impact on the water environment and reduces greenhouse gas emissions through energy saved from pumping. Our Water Resources Management Plan explains that we do not take water efficiency to mean restricting or reducing the use of water appliances (for example by showering less or not watering the lawn at all).

Section 4.1 describes how climate change may have consequences for our supply/demand balance and the process used to arrive at the conclusion that we are not affected by climate change in this area of the business.

It is for this reason that we have not developed any adaptation actions intended to reduce the effect climate change may have on our organisation through increased water scarcity. We are confident that we are resilient to even the worst case predicted climate change scenarios and will maintain this resilience until the end of our planning horizon at least.

We are confident that our organisation, stakeholders, and customers will remain unaffected by the impact of climate change on the supply/demand balance in our region until the end of our planning horizon. Our studies show that climate change will not have consequences for our supply/demand balance until well after the end of our planning horizon.

We will continually monitor this important aspect of water resources management and through our periodic statutory reporting process, communicate our updated findings. We feel that this method will enable us to appropriately adapt our approach and develop adaptation programmes in the future if risks should occur.

We have a good supply-demand balance such that any drought in the future would have to be much more severe in intensity or duration than experienced hitherto to require the implementation of any adaptation actions. We have several options to augment supply and reduce demand that would be actioned as a drought developed. Subject to not causing significant environmental damage we will seek to implement supply side actions and non-compulsory demand side actions before imposing compulsory restrictions on customers.

5.2 Flood Risk

We take the possibility of increased flood propensity very seriously and continually monitor and plan accordingly. Our flood defences are constantly updated to remain effective but we are also reliant on the Environment Agency to implement flood protection measures for interdependent assets. These are sites and facilities not belonging to us but of consequence to our operations, i.e. around power generation facilities etc. For example, flood levels may not be high enough to cause our pumping and treatment works to shut down, but if power generation facilities in the region are not adequately prepared, we may lose power and be unable to operate.

As this report has mentioned, our customers are at an extremely low risk to the effects of flooding on our facilities. UKCP09 projections indicate that large flooding events may become more common through the 21st century and so we have subsequently assessed our current resilience to flooding as detailed in Section 4.2. This study considered the consequences of climate change flood events, estimated to equate to 1 in 100 year flow + 20% levels.

The study showed that none of our sites will be affected by flooding caused by climate change and it is for this reason that we have not developed an adaptation programme. Therefore we are confident that our organisation, stakeholders, and customers will remain unaffected by climate change flood events.

We will continually monitor flooding in our region and through our periodic statutory reporting process, communicate our updated findings. We feel that this method will enable us to appropriately adapt our approach and develop adaptation programmes in the future if risks should occur.

5.3 Improving Network Resilience

As this report has mentioned, climate change may affect the behaviour of ground in our region, increasing the likelihood of bursts and leakage. For this reason it is important for us to consider climate change in predicting future leakage levels in our region.

Figure 4.1.b has previously illustrated the scope and quantity of sources which contribute towards our demand projections. Despite leakage being a large part of this, at no point in our planning horizon does leakage threaten to affect our supply/demand balance. For this reason we cannot justify investment in any programmes to adapt to the effects of climate change on our network.

We have a highly developed and integrated network of almost 1000 km of mains, and record one of the lowest levels of leakage (5.04 MI/d) in the industry. We believe it is important to reduce the waste of water where possible and so will continue to monitor leakage and ensure it is maintained at a sustainable and cost efficient level. The leakage targets based on social, environmental and financial costs will be reassessed when appropriate. This approach to leakage has been supported by our customers and regulators.

Through this process of continual monitoring and repair we will retain flexibility which will enable us to adapt our approach if and when climate change affects leakage in our region. Our studies, as detailed in our Plans, show that our organisation, stakeholders, and customers will remain unaffected by the effects of climate change on our network until the end of our planning horizon at least.

6 UNCERTAINTIES

As the recent report by PricewaterhouseCoopers LLP (*Adapting to Climate Change in the Infrastructure Sectors: Maintaining robust and resilient infrastructure systems in the energy, transport, water and ICT sectors*) highlights that the water industry is generally well informed on the physical effects of climate change. We are considered one of the leading sectors in preparing for, and adapting to, climate change and believe that we are adequately aware of the consequences and appropriate actions needed. However, there are many aspects of climate change adaptation beyond our control which remain unexplored and areas in which uncertainties exist.

Uncertainty should not be a reason for inaction. Our adaptive management allows for adjustments (as this report has shown) as additional and better information becomes available. Adaptive management requires continuous feedback and adjustments based on the information provided by our monitoring networks.

6.1 Legal and Regulatory Uncertainties

The evolution of the structure and shape of water regulation over the next 25 years is difficult to predict. We hope for new approaches, including more co and self-regulation, greater regard for variations in risk, increased regulatory consistency and long-term clarity, and less micro-management by regulators. We hope to work closer with our financial regulator Ofwat, in order to reduce the consequences of uncertainty in the way our industry is regulated in the future. We hope that by working together with our regulators towards a unifying goal of adaptation, we will be able to overcome barriers posed by our regulators and introduce adaptation programmes in the best interests of ourselves and our stakeholders.

In assessing risks and developing our plan for adaptation we have made the assumptions mentioned in this report. We have worked on the basis that legal, financial, and regulatory restrictions placed on us will not change beyond the parameters discussed in our Plans. Where we foresee a future difference to current practice we have included this in our planning. Unfortunately, there is very little else that can be done to mitigate the uncertainties arising through regulatory, financial, and legal changes throughout our planning horizon, but through our constant monitoring and evaluation of our approach (in the form of our Plans) we can ensure these uncertainties are addressed when information becomes available.

6.2 Data Reliability

Data used during our risk assessments and studies which contribute towards our Plans include a certain degree of uncertainty. With specific regards to our supply/demand balance this has been modelled in our headroom and explained in more detail in the relevant sections of our Water Resources Management Plan. However our studies show that even under worst case scenarios, we will remain unaffected by the effects of climate change. We anticipate that any data irregularities which emerge throughout our planning horizon will be easily dealt with thanks to the resilience to climate change embedded in our operations.

Although we are not alone in using the external data sets as detailed in our Water Resources Management Plan, we do recognise that their reliability and accuracy is not guaranteed. With more accurate data we may arrive at different conclusions which force us to alter our assessments. We are statutorily obliged to produce updated Plans ever 5 years and so through this mechanism we are able to constantly monitor up to date published data and re-evaluate the identified consequences of climate change on our operations.

We are confident that data used in our planning is the most accurate available and that our decision to defer any adaptation actions until the consequences materialise is well justified. We are able to maintain our level of service to our customers but will work with our regulators to ensure this. Our Plans are subject to review and so are confident that any assumptions made in our planning are approved by our regulators to ensure our customers receive the best possible service.

6.3 Water Quality

As a business, we are regulated by not only Ofwat but also by the Drinking Water Inspectorate (DWI) who monitor the quality of water in our supply. Water companies which fail to meet quality standards can face legal action, financial penalties and additional costs associated with the work to correct the fault. Water quality is a serious issue with many water borne illnesses being potentially life threatening.

We are unable to function as a business unless we can provide water which meets quality control standards. Contamination of supply can also affect the aesthetic standard of our water reducing customer's confidence in our ability to provide a safe product.

We work diligently to ensure our product is of the highest quality and have an exceptional safety record. However, there are many unknowns currently with the precise effects of climate change on our water quality.

We understand that higher water temperatures and changes in the timing, intensity, and duration of precipitation can affect water quality but cannot effectively quantify the effect climate change may have.

Flood magnitudes and frequencies will very likely increase in most regions, mainly as a result of increased precipitation intensity and variability. Flooding can affect water quality, as large volumes of water can transport contaminants into water bodies and also overload storm and wastewater systems.

A UKWIR report, *Climate Change Implications for Water Treatment*, due to be published in February 2011, will attempt to quantify the effect of climate change on surface water quality.

Using the findings of this report we will begin to understand the consequences of climate change on water quality and plan effectively for future effects. At present we cannot say with any certainty how much of a risk climate change is to our product quality. We will continue to participate in research in this area and will continue our diligent monitoring and treatment processes which ensure we deliver high quality drinking water to our customers.

We currently do not know enough to generate specific adaptation actions but will continue to work across the industry to research this topic.

6.4 Effects of Climate Change

We have developed our adaptation program in line with current identified consequences however many of the actual physical effects of climate change remain unknown. We have considered the UKCP09 projections and are confident that there will be changes in weather and climate but it is impossible to accurately predict what this variation will be, and to what degree it will affect business operations. UKCP09 projections are the most reliable data sets with regard to climate predictions in our area, but these will need constant monitoring and updating to ensure our periodic Plans remain accurate.

It is also almost impossible to accurately differentiate between changing weather patterns and behaviours, and consequences which are as a direct result of climate change. Variable weather may be a possible symptom of climate change but it is unknown to what extent it may have been as a direct result of.

Years of data will help us to prove that weather events such as floods and droughts are becoming more common because of climate change, and would not have just occurred regardless. Being able to clearly identify the risks due to climate change alone will also enable us to assign an associated financial cost. This will allow us to justify our operations to not only our economic regulator but to our customers as well.

We feel that by considering the worst case scenarios detailed in the UKCP09 projections, we will be adequately prepared should discrepancies in the data emerge. We may find that climate change effects that we had previously not considered may bring new consequences for our operations, or identified effects may develop into more serious issues. We will be in a position to adapt having already deeply embedded a high level of resilience in our company operations. Our risk assessment methodologies and plans for adaptation are flexible and we believe that despite being aware of potentially inaccurate data, feel that we are adequately prepared.

Our current risk assessment methodology considers all effects of changing weather and not just climate change independently. This approach has so far proved effective in ensuring we fulfil our business functions and remain a leading organisation in the water industry. This report has justified our regulators and our own confidence in our planning approach but it may become apparent in the future that this requires adapting and a more climate change focussed methodology is necessary.

6.5 Risks to Administrative Operations

Like any organisation, we need to ensure that we have the facilities and systems in place to support our activities. We also have a legal requirement to be able to deliver certain critical services at all times, such as emergency provisions for water. To do this we need appropriate buildings, equipment and vehicles and relevant protocols to safeguard our staff and stakeholders.

Our current risk assessment methodology assesses the effect weather may have on our operational capacities. Adverse weather conditions not only create a dangerous working environment but are recognised to reduce work output. We must comply with our duties under Regulation 3 of the Management of Health and Safety at Work Regulations 1999.

We do not currently have a set methodology specifically designed towards assessing how climate change may affect our operational capabilities in the future. However we make use of expert analysis of published reports and historical precedent to ensure our administrative functions remain resilient.

Important industries to our administrative functions, such as telecommunications, transport and energy transmission, are due to publish their adaptation reports throughout the reporting process. These documents will allow us to make informed decisions on the quantifiable risk to our business due to climate change.

Power failures are a distinct possible effect of climate change; without power, our administrative capabilities will be limited. Following the publication of the adaptation reports from the energy sector, we will be able to more accurately quantify how our administrative functions will be affected by energy failure.

Due to the nature of our business, many of our operational sites are in rural areas and so adverse weather conditions may hamper our efforts to access assets. Access to urban facilities, such as our head office, may also become more difficult for staff. PricewaterhouseCoopers LLP sector summary on transport identifies 80 highways agency activities which may be at risk of climate change, and points towards a future where the reliability of our roads network is not guaranteed. Rail connections are also at risk according to the report, with particular mention made to the effect of flooding. We will have to re-evaluate this issue following the publication of the transport sector adaptation reports.

Our business is heavily reliant on information and communication technology to help us monitor, and maintain our network. The PricewaterhouseCoopers LLP report states that due to the nature of the communications industry, long term planning for climate change is not a priority. However, there is an overall recognition that many communications infrastructure assets are exposed to weather related disruption. The dependence of many other sectors on ICT also means that extreme weather events could place strains on the capacity of the networks. The exact nature of this risk will become more apparent following publication of adaptation reports from this sector.

To help ensure we remain fully operational we have recently introduced flexible working hours and facilitate our staff members to work at home wherever possible. This will help our staff continue to work in the event of adverse weather conditions and ensure our service to our customers remains unaffected.

7 BARRIERS TO ADAPTATION

7.1 Regulation and Legislation

We expect the legal and regulatory requirements which we meet to become more onerous. This is not simply a question of requirements in respect of drinking water. We expect new national and international requirements to mitigate climate change, implying limitations on carbon emissions. The form that new legal requirements will take is currently unknown.

Limitations on abstraction of water for public supply from the Environment Agency are likely to become more stringent, in part as a result of progressive tightening under the Water Framework Directive.

Uncertainty over future regulatory and legislative changes has been modelled in our headroom and we feel that we are in good position to monitor and re-assess this situation through publication of our Plans.

7.2 Resources

In practice when set against the criteria of value for money, Ofwat need to consider the impact on customers' bills and consumers' willingness to pay. Climate change adaptation is not considered in our customer's willingness to pay studies and for this reason it may be difficult to justify these investments to Ofwat. To overcome this, we will continue to work closely with other water companies and organisations, regulators, and our customers in order to ensure that Ofwat are acting in our customer's best interests.

We will need years of experience to form an effective methodology for choosing investments but we will also need to work closely with the industry to achieve this. Ofwat have been pushing for a more transparent and considerate investment approach and it is hoped that the financial implications of climate change will motivate our industry and regulators to improve in this topic.

7.3 Knowledge

Uncertainties associated with the UKCP09 projections and with other data mentioned in this report may make development of effective adaptation strategies difficult. In order to retain investor confidence to justify large scale investments, and to be sure we are acting in the best interests of our customers, we require a reliable evidence base.

We use the most reliable evidence bases available to us and cooperate with the Environment Agency, Defra, and all our regulators in our research. We will continually update and evaluate our Plans through the periodic reporting process and so will be in a position to act when future risks are identified and justification for adaptation actions found. Through this research we will reduce uncertainty and barriers to adaptation.

7.4 Interdependencies and Stakeholders

We rely heavily on a number of other key industries and authorities. For example, our calculation of almost 100% resilience to 1:1000 year flooding is undermined if flood defences at power generating sites which supply us with electricity for pumping and water treatment are poor. For this reason although we can move to increase resilience of our business in areas, the benefits of these investments will not materialise if other stakeholders do not invest similarly.

In order to overcome this we will work with our interdependencies and regulators such as the Environment Agency to ensure that our adaptation actions remain appropriate. It is hoped that one of the outcomes from the first UK national adaptation programme will be reassurance that all important industries are equally well prepared for the effects of climate change.

We will continue to work with stakeholders, conduct willingness to pay surveys and undertake research in this area to determine the amount extra customers are willing to pay for climate change adaptation projects. We will work closely with others on whom we depend and with those who depend on us on the subject of climate change adaptation and feel that the requirement for preparing statutory adaptation plans will enable closer cooperation on climate change issues. We will work with Defra to help facilitate cooperation across key infrastructure and utility owners.

Power cuts could become common as weather conditions cause failures across the energy transmission sector. This, combined with potential future power shortages, will affect the way we pump water across our network. At present, night time pumping is employed to take advantage of reduced energy costs, but if energy tariffs change, more intensive pumping during periods of lower cost will place huge strain on equipment and the network which may not currently have a high enough peak capacity to cope.

We currently have no plans to introduce micro generation capabilities sufficient to compensate for power cuts, and so will rely heavily on the resilience of our energy suppliers. If the energy industry is not appropriately prepared for the future then we will be affected as a result.

8 MONITORING AND CONCLUSION

Changing weather caused by climate change will directly affect our organisation in a number of ways, but it is only through our continued monitoring and research that we can be sure that our current actions remain appropriate. Our studies which contribute towards our future planning consider all environmental considerations and climate change has been a part of that for a long time. This report has shown that while we are well prepared for the effects of climate change until the end of our planning horizon, this resilience was not brought about by considering climate change as a specific risk to our organisation.

It is likely that with more adverse weather conditions, we will face new challenges, ones which until now have not been standard occurrences in our region for example, large-scale flood events and droughts. This apparent contradiction highlights the issue of how important knowledge of the actual physical effects of climate change will be and we will continue our efforts to increase our understanding in this topic.

We have, and will continue to prepare for whatever environmental conditions climate change will bring. We have extensively studied various climate models, including the UKCP09 projections from UKCIP but also include historical data and expert opinion wherever possible. By embedding climate change adaptation in our organisation we anticipate that we will continue to function effectively in this region and will have the knowledge and experience to adapt to suit our changing environment.

8.1 VWE and Climate Change

We feel that our current system of operating should serve us well when adapting to climate change in the future. It is flexible enough to respond to any current plausible weather scenario and as this report has shown, effective at identifying changing conditions within our planning horizon. Through our periodic Plans we are able to continue communicating our findings concerning future conditions to our own organisation, stakeholders and customers. Monitoring and preparing for the consequences of climate change is part of our usual planning and this report has shown how our current methodologies and approach is effective.

We aim to take into account worst case scenarios in our planning wherever possible, as our approach to water resources management shows, and feel that our current abstraction and operational methods should be an appropriate framework from which to implement any future adaptation actions.

As a water company, we are already in the process of adapting to the effects of climate change and feel that the industry as a whole is well informed of the environmental changes we face. We devote a considerable amount of resources to monitoring the effects of changing weather patterns and believe that our planning approach is justified and well researched. We operate in an area which experiences less than the average UK rainfall and it is for this reason that we consider our future planning very seriously in order to continue supplying drinking water to our customers.

8.2 Moving Forward

Going forward we will continue to monitor our priority risks outlined in this report. Through periodic development of our associated Plans, we will record environmental changes over time and modify our actions as appropriate to ensure we can guarantee our business functions across our planning horizon. Our risk assessment methodology, although flexible, may also change depending on our monitoring outcomes.

We will continue to develop our evidence base with others and ensure that our assets and operations are sufficiently resilient to the effects of climate change. As a water company, our performance is intrinsically linked to the environment and therefore a changing climate is of particular importance to us.

If we are able to overcome the barriers mentioned, and remove many uncertainties, it is possible that we will be able to accurately quantify the effect of climate change over and above general changes in our region and prepare adaptation actions accordingly. In order to do this we will work closely with our regulators to ensure our actions remain appropriate and that we can guarantee service to our customers beyond our planning horizon.

This report has shown that we have a clear understanding of the consequences of climate change on our operations. We have made well evidenced and justifiable decisions with regard to our adaptation actions which represent the best possible deal for our customers. Despite having not completed a specific risk assessment to assess the effects of climate change, our planning approach and methodology is verified to be appropriate by our regulators. We feel that we are as well prepared as is realistically possible until the end of our planning horizon at least and that our customers and stakeholders have every reason to be confident in our ability to maintain our excellent position within the industry.

A. APPENDIX A - CRANFIELD EVALUATION FRAMEWORK: KEY ATTRIBUTES CROSS REFERENCE

This Appendix allows for easier cross reference between the key attributes and sub-attributes of the Cranfield evaluation framework. The Cranfield evaluation framework specifically covers only the risk assessment component of the adaptation reports.

The references provided in this appendix are by no means exhaustive and the main report should be consulted for full details. Assessing the risks as a result of a changing climate and preparing adaptation actions is an integral part of our business operations and so therefore our risk assessment methodology, results and monitoring processes are integrated in all of our decisions. Our approach differs between many of our identified risks and so the main report should be consulted and considered on a risk by risk basis.

Table A: Attributes and sub-attributes of the evaluation framework and relevant cross reference within main report

Key Attribute	Sub-Attribute	Report Reference
1. Climate change risk assessment is a clear component of corporate risk appraisal.	1.1 Climate change demonstrably a key consideration in corporate planning and processes of the Reporting Authority.	2.2, 4
	1.2 Reporting Authority presents a clear analysis of climate risks on business operations for specified periods into the future and includes high priority climate related risks and timescales.	4
	1.3 Adaptation plan is clearly embedded in the core of the Reporting Authority's business.	5
	1.4 Reporting Authority includes some prior evaluation of how its climate change risks impact upon or are affected by stakeholders.	4.1, 4.2, 4.3
	1.5 Reporting Authority considers the existing policies and procedures related to climate impacts, and the effect the weather has on operations and achievement of the organisation's strategic objectives.	4.1, 4.2, 4.3
2. Climate change risk assessment enables the Reporting Authority to make evidence based decisions on adapting to climate change	2.1 Reporting Authority adopts a conceptual risk management framework for organisational, rather than locational risks.	3
	2.2 Reporting Authority identifies the key climate variables and their potential impact on the organisation.	4.1, 4.2, 4.3
	2.3 Reporting Authority provides clear criteria for likelihood and consequence that are appropriate and specific to their organisation.	3.1.2
	2.4 Reporting Authority's risk assessment quantifies, or otherwise estimates or characterises the impact and likelihood of risks occurring at various points in the future.	3.1
	2.5 Reporting Authority presents all the	Appendix C

	organisation's strategic risks from climate change on a likelihood/consequence matrix, where possible including the climate thresholds above which climate change poses a threat to the organisation. Where it is not possible, the Reporting Authority should set out how it will investigate thresholds.	
	2.6 Reporting Authority considers short, medium and long term risks of climate change disaggregated into different locations where appropriate, and includes an assessment of the level of confidence in these calculations.	4
3. Demonstrable use of relevant and appropriate data, information, knowledge, tools and methodologies	3.1 Reporting Authority adopts the latest set of UK Climate Projections (currently UKCP09) or other appropriate scenarios or climate information.	4.1, 4.2, 4.3
	3.2 Reporting Authority demonstrably assesses using the best evidence suitable to organisational need.	4.1, 4.2, 4.3
	3.3 Reporting Authority's risk assessment includes consultation with interested parties or stakeholders.	3.1
4. Climate change risk assessment and adaptation measures explicitly consider uncertainties.	4.1 Reporting Authority's risk assessment includes a statement of the main uncertainties in the evidence, approach and method used in the adaptation plan and in the operation of the organisation.	6
	4.2 Reporting Authority's adaptation responses explicitly account for uncertainties and interdependencies of actions, including the actions of others on the adaptation plan.	5
	4.3 Reporting Authority's adaptation plan includes a clear statement of assumptions which are well evidenced.	5, 6
5. Climate change risk assessment generates priorities for action	5.1 Reporting Authority provides priority areas for action that are demonstrably linked to the development of a risk based adaptation plan	5
	5.2 Reporting Authority's adaptation plan includes a detailed action plan covering its priority areas. This should ideally include timescales, resources and responsibilities and be included in the report.	5
	5.3 Reporting Authority's risk management actions are targeted to demonstrably reduce risks to a defined level of residual risk	3, Appendix C
	5.4 Reporting Authority's adaptation plan is subject to appraisal against sustainability principles, and specifically to an appraisal of	5

	costs and benefits.	
6. Climate change risk assessment identifies opportunities	6.1 Reporting Authority's risk assessment allows an evaluation of net benefits and/or opportunities arising from the impacts of climate change	8
7. Clear demonstration of flexible adaptation measures	7.1 Reporting Authority's adaptation plan includes strategies to deal with the level of quantified risk and retains flexibility over which future course of action to follow as knowledge improves and projections change.	5
	7.2 Reporting Authority's adaptation plan includes a statement of the barriers to implementation and a means for overcoming these.	7
8. Monitoring and evaluation of adaptation effectiveness	8.1 Where possible, the Reporting Authority's report shows progress already made against its adaptation plan.	5
	8.2 Reporting Authority makes clear provision for the evaluation of the effectiveness and viability of its adaptation plan.	5, 8
	8.3 Reporting Authority makes clear provision for monitoring thresholds, above which climate change impacts will pose a risk to the organisation, and their incorporation into future risk assessments.	5, 8
	8.4 Reporting Authority makes clear provision for the monitoring of residual risks from climate change on the organisation and its stakeholders.	5, 8
	8.5 Reporting Authority offers evidence that the production of the risk assessment and adaptation plan has led to a change in the organisation's management of climate risks.	8

B. APPENDIX B - STATUTORY GUIDANCE TO REPORTING AUTHORITIES: BOX 2 CROSS REFERENCE

This Appendix allows for easier cross reference between Box 2 of the Defra Statutory Guidance (*Adapting to Climate change: helping key sectors to adapt to climate change*) and the main body of this report. The statutory guidance to reporting authorities has been issued by the Secretary of State to reporting authorities under powers contained in the Climate Change Act 2008. Its purpose is to provide reporting authorities with guidance and structure when assessing risks due to climate change and developing adaptation actions. Box 2 of the guidance is a summary of what the Secretary of State expects to see on receipt of the completed report.

Veolia Water East's report is of a very similar structure to that laid out in Box 2 and that of the Executive Summary from the same guidance document. As with Appendix A, many of the themes addressed in this table are discussed throughout the entirety of the main report.

Table B: What to include in a report according to Box 2 of the statutory guidance and relevant cross reference within main body of report.

Attribute	Sub-Attribute	Report Reference
1. Functions impacted by climate change	a. What are your organisation's functions, missions, aims and objectives?	2.1, 2.2
	b. Which of these will be affected by the current and possible future impacts of climate change?	2.2
	c. Have you assessed the climate thresholds above which climate change and weather events will pose a threat to your organisation? If so what were the main results?	4
	d. Who are your organisation's key stakeholders? Do you need to assess the impacts of climate change on them?	2
2. Approach	a. What evidence, methods and expertise have you used to evaluate future climate impacts? List sources and references.	4
	b. How do you quantify, or otherwise estimate or characterise the impact and likelihood of risks occurring at various points in the future?	3
	c. How have you evaluated the costs and benefits of proposed adaptation options?	5
3. Summary of risks which affect functions,	a. List all the organisations' strategic risks from climate change on a likelihood/consequence	Appendix C

mission, aims, and objectives	matrix – including thresholds where applicable.	
	b. What short and long term impacts of climate change have you identified and how are each factored into the adaptation programme? Quantify the likelihood and consequences as far as possible (including an assessment of the level of confidence (e.g. high/medium/low) in the calculations) and disaggregate these risks to different locations where appropriate.	4
	c. What are your high priority climate related risks and why (stating level of impact to business, likelihood, costs and timescales)?	4.1, 4.2, 4.3
	d. What opportunities due to the effects of climate change which can be exploited, have been found?	8.2

4. Actions proposed to address risks	a. What are the adaptation actions for the top priority risks (stating timescales)?	5.1, 5.2, 5.3
	b. How will the adaptation actions be implemented (stating level of responsibility, investment and timescales)?	5
	c. How much do you expect these adaptation measures to cost and what benefits do you anticipate will result from them?	5
	d. How much do you expect them to reduce risk by, and on what timescales?	5
	e. How will you ensure the management of climate change risks is embedded in your organisation?	8

5. Uncertainties and assumptions	a. What are the main uncertainties in the evidence, approach and method used in the adaptation programme and in the operation of your organisation?	6
	b. What assumptions have been made when devising the programme for adaptation?	6

6. Barriers to adaptation and	a. What are the barriers to implementing your organisation's adaptation programme?	7
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interdependencies	b. How will these barriers be addressed?	7.1, 7.2, 7.3, 7.4
	c. What/who are the interdependencies (including the stakeholders stated in response to question 1d)?	7.4

7. Monitoring and evaluation	a. How will the outcome of the adaptation programme be monitored?	5
	b. How will the thresholds, above which climate change impacts will pose a risk to your organisation, be monitored and incorporated into future risk assessments?	5, 8
	c. How will the residual risks of impacts from climate change on your organisation and stakeholders be monitored?	5, 8
	d. How will you ensure that the management of climate change risks is firmly embedded in your organisation?	8
	e. How will you enable your management of climate change risk to be flexible?	5, 8
	f. Has the production of this report led to a change in your management of climate risks?	8.2

C. APPENDIX C - LIKELIHOOD/SEVERITY MATRIX FOR IDENTIFIED CLIMATE CHANGE RISKS

Our risk assessment approach is detailed in Section 3 and uses a ranking system to identify risks and to divert resources for control actions to where they are needed most. However for the purposes of this report, and to fulfil our statutory reporting obligation, our identified risks have been transferred to a common likelihood/severity matrix. This will allow for easy comparison across the sector but it is worth noting that this is not standard procedure for us. Table 8.2.a below outlines the classification for each identified risk.

Table 8.2.a: Likelihood/severity

Descriptor	Guide
High risk	Should trigger a review of existing controls, is likely to require the implementation of additional controls and the problem should be escalated to the RMC (Risk Management Committee) or relevant committee for consultation. Risk reduction measures should be implemented within a defined time period. Risks with this score should be reviewed monthly.
Significant risk	Should trigger a review of existing controls for new risks, and may require the implementation of additional controls for existing risks and the problem may be escalated to the RMC (Risk Management Committee) or relevant committee for consultation. Risk reduction measures should be implemented within a defined time period. Risks with this score should be reviewed monthly.
Moderate	Should trigger a review of existing controls for new risks, and may require the implementation of additional controls for existing risks. Risk reduction measures might need to be implemented within a defined time period. Risks with this score should be reviewed quarterly to twice a year.
Low risk	Should require no mitigation action. However, risk owners should review controls for low risk areas to ensure they are effective and not disproportionate. The risk score should be reviewed annually.

With and Without Controls in Place

SEVERITY LIKELIHOOD	Low	Quite serious	Serious	Very Serious
Very High				
High				
Medium	<ul style="list-style-type: none"> • INCREASED DEMAND • BURST RESULTING IN LOSS OF SUPPLY DUE TO GROUND MOVEMENT 			
Low	<ul style="list-style-type: none"> • REDUCED SUPPLY 	<ul style="list-style-type: none"> • FLOOD RISK 		

As this report has endeavoured to explain, we do not consider ourselves to be at risk to the effects of climate change. Therefore adaptation to climate change programmes are unnecessary and have not been commissioned based on our available evidence. We feel that it would be difficult to justify investment to our stakeholders, regulators, and customers. For this reason, there are no controls proposed and so no way to demonstrate on a similar matrix how our actions will reduce the risk.